PRODUCT CLASSIFICATION BASED ON COLOR TAGS USING RGB SENSORS

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ABSTRACT

To design a single hardware circuit for product classification that comprises multiple slots for sensors, motors, LCD, switches. The **color sensor TCS3200 interfaces with arduino uno**. TCS3200 is a color sensor which can detect any number of colors with right programming. TCS3200 contains RGB (Red Green Blue) arrays. On microscopic level one can see the square boxes inside the eye on sensor. These square boxes are arrays of RGB matrix. Each of these boxes contains three sensors, Each of sensor arrays in these three arrays are selected separately depending on requirement. The module can be featured to sense the particular color and to leave the others. It contains filters for that selection purpose. It can be useful for color identification and detection for food-processing units, color printer applications, paint-mixing applications and other industrial applications including robotics. We can implement it just by dumping the code into the arduino uno.

Keywords: LCD, motors, TCS3200 sensors, arduino uno.

INTRODUCTION

A common requirement in the field of color sensing is that of color identification, or sorting of objects by color. Typically this type of application is simpler than a general-purpose color measurement application, since all we are interested in is identifying which of a predefined list of categories a color belongs. The TCS3200 is an RGB color sensor capable of making high-resolution color measurements using the three values obtained from its red, green, and blue sensors. This technique can be used in applications such as LED sorting and testing, industrial sorting and identification, process control in labeling and printing machines, etc.

By using RGB sensor, motor driver circuits and some essential components the colors can be sorted by placing the color tag in front of the sensor and after detecting particular color then corresponding motor will rotate and that colored ball will fall into box in this way the products are classified by using color tags.

LITERATURE SURVEY

According to the induction principle of the three primary colors which create various other colors in nature, once the value of three primary colors is confirmed, the color of the tested object is known. Knowing the value of RGB helps people gain the color of the light which is projected onto the sensor since each color correspond to only one value. The color sensor identifies color and gives serial output of RBG value. It can identify 16.7 million color shades giving RGB value for the detected color. The detected color is identified as amount of three primary color values namely Red, Green & Blue with 8 bit accuracy for each primary color. Any color can be separated or combined into three primary colors Red, Green and Blue using the RBG values.

The output of this color sensor is Principle of Color Identification. The sensor switches each primary color RGB, one by one and checks what intensity of color is reflected by the surface of detection. This reflected intensity is converted to 8 bit value. For example a RED surface will strongly reflect RED. While a YELLOW surface will reflect RED and GREEN both connected to RC7 of the MCU shown above the pins of IC L293D is connected to RB0, RB1, RB2 and RB3 of the MCU to drive the base motor arm motor 1 respectively.

LCD display is used for displaying the status of the system. LCD module is a dot matrix liquid crystal display that displays alphanumeric, kana (Japanese character) and symbols. The built in controller and driver LSI, provide convectional connecting between LCD and most 4 or 8 bit microcontroller. The CMOS technology makes the device ideal for applications in handheld portable and other powered instruments with low power consumptions.

PROPOSED METHOD

This paper is used for detecting primary colors (red, green and blue, or RGB) colors that are physically available in LEDs in one package; for example, common cathode or common-cathode RGB LED. When the particular color will detect by the sensor, then the Microcontroller will get the corresponding color signal and according to that it will control the device.

A. LCD Display:

In 16x2 LCD there are 16 pins over all if there is a back light, if there is no back light there will be 14 pins. One can power or leave the back light pins. Now in the 14 pins there are 8 data pins (7-14 or D0-D7), 2 power supply pins (1&2 or VSS&VDD or GND&+5v), 3rd pin for contrast control (VEE-controls how thick the characters should be shown), and 3 control pins (RS&RW&E)

In the circuit, there are two control pins. The contrast bit and READ/WRITE are not often used so they can be shorted to ground. This puts LCD in highest contrast and read mode. We just need to control ENABLE and RS pins to send characters and data accordingly.

To establish a good communication between human world and machine world, display units play an important role. And so they are an important part of embedded systems. Display units - big or small, work on the same basic principle. Besides complex display units like graphic displays and 3D dispays, one must know working with simple displays like 16x1 and 16x2 units. The 16x1 display unit will have 16 characters and are in one line. The 16x2 LCD will have 32 characters in total 16in 1st line and another 16 in 2nd line. Here one must understand that in each character there are 5x10=50 pixels so to display one character all 50 pixels must work together. But we need not to worry about that because there is another controller (HD44780) in the display unit which does the job of controlling the pixels. (you can see it in LCD unit, it is the black eye at the back).

B. 16×2 LCD Interfacing with Arduino Uno:

The connections which are done for LCD are given below:

PIN1 or VSS to ground
PIN2 or VDD or VCC to +5v power
PIN3 or VEE to ground (gives maximum contrast best for a beginner)
PIN4 or RS (Register Selection) to PIN0 of ARDUINO UNO
PIN5 or RW (Read/Write) to ground (puts LCD in read mode eases the communication for user)
PIN6 or E (Enable) to PIN1 of ARDUINO UNO
PIN11 or D4 to PIN8 of ARDUINO UNO
PIN12 or D5 to PIN9 of ARDUINO UNO
PIN13 or D6 to PIN10 of ARDUINO UNO
PIN14 or D7 to PIN11 of ARDUINO UNO

The ARDUINO IDE allows the user to use LCD in 4 bit mode. This type of communication enables the user to decrease the pin usage on ARDUINO, unlike other the ARDUINO need not to be programmed separately for using it in 4 it mode because by default the ARDUINO is set up to communicate in 4 bit mode. In the circuit you can see we have used 4bit communication (D4-D7).So from mere observation from above table we are connecting 6 pins of LCD to controller in which 4 pins are data pins and 2 pins for control.Most LCDs with 1 controller has 14 Pins and LCDs with 2 controller has 16 Pins (two pins are extra in both for back-light LED connections).

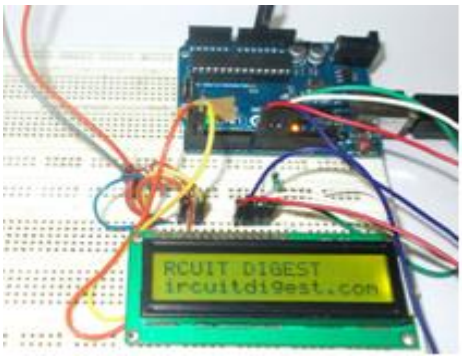


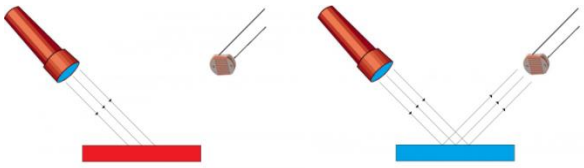
Fig: 16×2 LCD Interfacing with Arduino Uno

C. Color Sensors

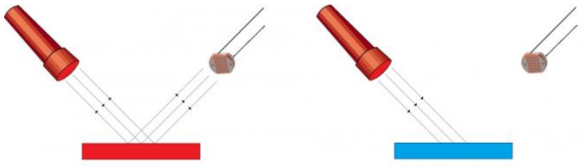
Technically speaking, colors are figments of our imagination. When we see a red apple, it means that it reflects that particular wavelength (~700 nm for Red) of the electromagnetic spectrum. This energy is absorbed by the eye and based on some chemical reaction; the brain says that particular wavelength is red color.

For computers, a sensor that differentiates between different colors will help in determining the color of the object. We will see a simple color sensor using a photo resistor (Light Dependent Resistor – LDR) and two different colored objects, say red and blue.

When we shine bright red light on both the objects, the red object will reflect the light whereas the blue object will absorb it. So, when red light is incident on both the red and blue objects, the red objects appears brightest to the LDR as it reflects most of the red light.



Similarly, when a bright blue light is incident on both the objects, the blue object will appear the brightest to the sensor. This method is just to understand the working of a color sensor and the actual results may not be accurate.



D. TCS3200 Color Sensor

Practical Color Sensors like TCS3200 are a bit more complicated. The TCS3200 color sensor is a programmable color sensor which converts color light to frequency. The output frequency of the sensor is directly proportional to the intensity of the light reflected from the object.

The TCS3200 Color Sensor Module has RGB + Clear Sensor along with 4 bright white LEDs embedded on the board. TCS3200 has an 8 x 8 array of photo diodes, 16 each for Red filters, Blue filters, Green filters and Clear (no filter).

E. Programmable color light-to-frequency converter

The functional block diagram of TCS3200 Color Sensor is shown in the following image. It consists of color filters, photo diode array, current to frequency converter and final square wave output which can be given directly to a microcontroller.

Fig: Color Sensor

The TCS3200 programmable color light-to-frequency converter combines configurable silicon photodiodes and a current-to-frequency converter on a single monolithic CMOS integrated circuit. The output is a square wave (50% duty cycle) with frequency directly proportional to light intensity (irradiance). The TCS3200 reads an 8x8 array of photodiodes.

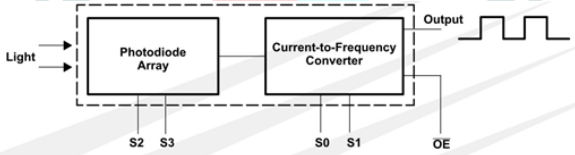


Fig: TCS3200 RGB Color Sensor

The TSC3200 Color Sensor IC is an 8 pin IC with SOC package. The following image shows the pin diagram of the Color Sensor IC. In that Pins 1 and 2 (S0 and S1) are output frequency scaling pins. Pin 3 is Output enable pin and is an active low pin. Pin 4 is GND.

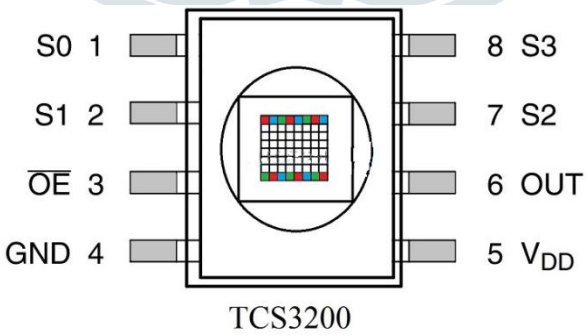


Fig: Pin Diagram of TCS3200

Pin 5 is the VDD pin and the maximum supply voltage is 5.5 V. Pin 6 is the output pin through which we can get the square wave output. Pins 7 and 8 (S2 and S3) are Photodiode selection pins.

Pins 1, 2 (S0, S1) and 7, 8 (S3, S4) are of special interest in TCS3200 Color Sensor. S0 and S1 are output frequency scaling pins. With these pins, the frequency of the output square wave can be scaled according to the application or microcontroller used.

The reason for scaling of output frequency is different microcontrollers have different timer configurations and there might be some limitations in the counter functionality of the microcontrollers. The following table shows the percentage of output scaling for different combinations of S0 and S1.

S0	S1	Output Frequency Scaling (f_0)
L	L	Power Down
L	H	2%
H	L	20%
H	H	100%

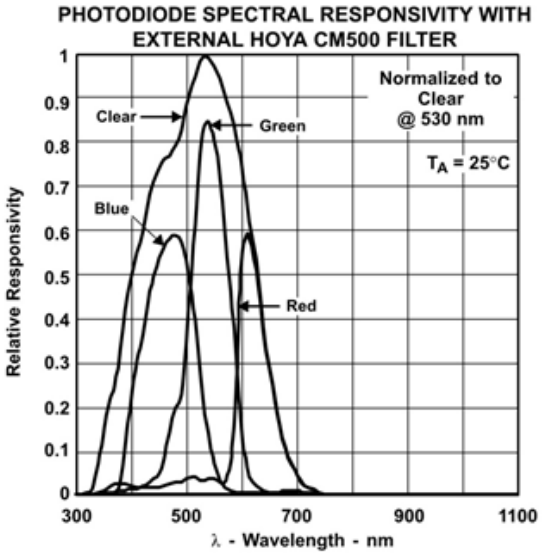
The signal frequency sent by module can be modulated depending on use. We can change the output signal frequency bandwidth.

The frequency scaling is done by two bits S0 and S1. For convenience we are going to limit the frequency scaling to 20%. This is done by setting S0 to high and S1 to LOW. This feature comes in handy when we are using the module on system with low clock. The color which needs to be sensed by the color sensor is selected by two pins S2 and S3. With these two pins logic control we can tell sensor which color light intensity is to be measured. We need to sense the RED color intensity we need to set both pins to LOW. Once that is done the sensor detects the intensity and sends the value to the control system inside the module. So we have a system which sends out a square wave whose frequency depends on light intensity of color which is selected by S2 and S3

S2	S3	Photodiode Type
L	L	Red
L	H	Blue
H	L	Clear (no filter)
H	H	Green

The TCS 3200 Color Sensor comes in the form of a Module with all the components like header pins, 4 White LEDs, Resistors and Capacitors in addition to the Actual TCS 3200 Color Sensor. The following image shows the real time Color Sensor Module.

The Array sensitivity to color is shown in below figure.



F. Working

A simple Color Sensor using Arduino is developed in this paper. The color sensor module senses the color in its surroundings.

As mentioned in the introduction to color sensor section, the TCS3200 Color Sensor has filters for Red, Blue, Green and Clear. The intensity of each color is represented as a frequency. In Arduino, we have fixed the output frequency scale to 100% by applying HIGH to S0 and S1 pins of the color sensor.

We have to use the S2 and S3 pin on the color sensor to select the type of photo diode i.e. red, green or blue. Whenever a particular Photo diode is selected, the PULSEIN feature of the Arduino is activated on the pin that is connected to the output of the Color Sensor.

This will help us to calculate the frequency of the output signal. The same process is repeated for all the three photo diodes: R, G and B. The frequency in all the cases is measured using the PULSEIN feature and is displayed on the Serial Terminal.

Additionally, this information can be used to identify the color placed in front of the sensor and display its color on the LCD and also light up the corresponding LED.

G. ARDUINO UNO BOARD:

Arduino is a single-board microcontroller meant to make the application more accessible which are interactive objects and its surroundings. The hardware features with an open-source hardware board designed around an 8-bit Atmel AVR microcontroller or a 32-bit Atmel ARM. Current models consists a USB interface, 6 analog input pin and 14 digital I/O pins that allows the user to attach various extension boards.

The Arduino Uno board is a microcontroller based on the ATmega328. It has 14 digital input/output pins in which 6 can be used as PWM outputs, a 16 MHz ceramic resonator, an ICSP header, a USB connection, 6 analog inputs, a power jack and a reset button. This contains all the required support needed for microcontroller. In order to get started, they are simply connected to a computer with a USB cable or with a AC-to- DC adapter or battery. Arduino Uno Board varies from all other boards and they will not use the FTDI USB-to- serial driver chip in them. It is featured by the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to- serial converter.

SOFTWARE

A program for Arduino may be written in any programming language for a compiler that produces binary machine code for the target processor. Atmel provides a development environment for their microcontrollers, AVR studio and the newer Atmel studio.

The Arduino project provides integrated development environment (IDE), which is a cross-platform application written in a programming language java. It originated from the IDE for the language processing and wiring.It includes a code editor with features such as text cutting and pasting, searching and replacing text, automatic indenting, brace matching and syntax highlighting and provides simple one-click mechanisms to compile and upload programs to an Arduino board. It also contains a message area, a text console, a toolbar with buttons for common functions and a hierarchy of operations menus.

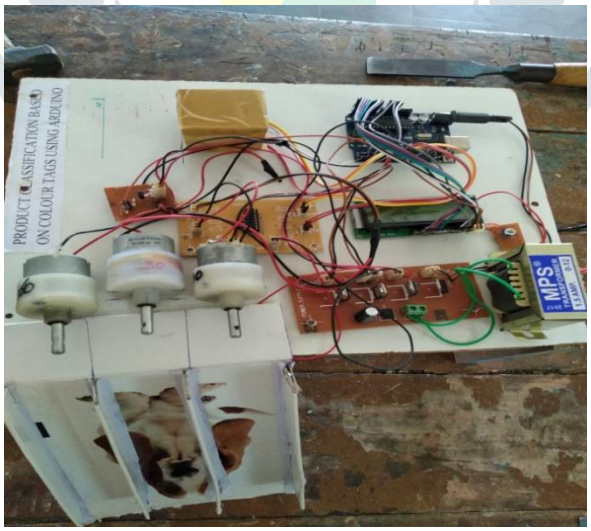
A program written with the IDE for Arduino is called a sketch. Sketches are saved on the development computer as text files with the files extension.ino. Arduino Software (IDE) PRE-1.0 saved sketches with the extension.pde

The Arduino IDE supports the language C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the wiring project, which provides many common input and output procedures. User-written code only requires two basics functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub main into an executable cyclic executive program with the GNU toolchain, also included with the IDE distribution. The Arduino IDE employs the program avrdude to convert the executable code into a text file in hexadecimal encoding that is loaded into Arduino board by a loader program in the board's firmware

APPLICATIONS

- Color Sensors have a wide range of applications in the fields of image processing, digital signal processing, object detection, color identification, etc.
- In industries, Color sensors are often used in sorting objects based on color.

EXPERIMENTAL RESULT



In this paper, we can identify the color by placing the color tags in front of the color sensor and after detecting the color the corresponding motor will rotate.

CONCLUSION

In this paper the color tag is placed in front of the sensor and after detecting particular color then corresponding motor will rotate and that colored ball will fall into box in this way the products are classified by using color tags.

REFERENCES

(1) AUTOMATED COLOR SENSOR SYSTEM USING LDR AND RGB LEDS CONTROLLED BY ARDUINO VOL. 12, NO. 19, OCTOBER 2017 ISSN 1819-6608 ARPN Journal of Engineering and Applied Sciences ©2006-2017 Asian Research Publishing Network (ARPN). All rights reserved.

(2) A. Pan Thu Tun, B. Khine Myint Mon_ Colour Paper Detection System IOSR Journal of Electronics and Communication Engineering (IOSR-JECE) e-ISSN: 2278-2834,p- ISSN: 2278-8735.Volume 11, Issue 5, Ver. I (Sep.-Oct .2016), PP 110-114 www.iosrjournals.org